Transitionen von der Erstausbildung ins Erwerbsleben
Transitions de l'Ecole à l'Emploi
Transitions from Education to Employment

UNIVERSITÄT BERN

Gender, mathematical self-concept, and occupational choice: New evidence from the second TREE cohort

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Outline

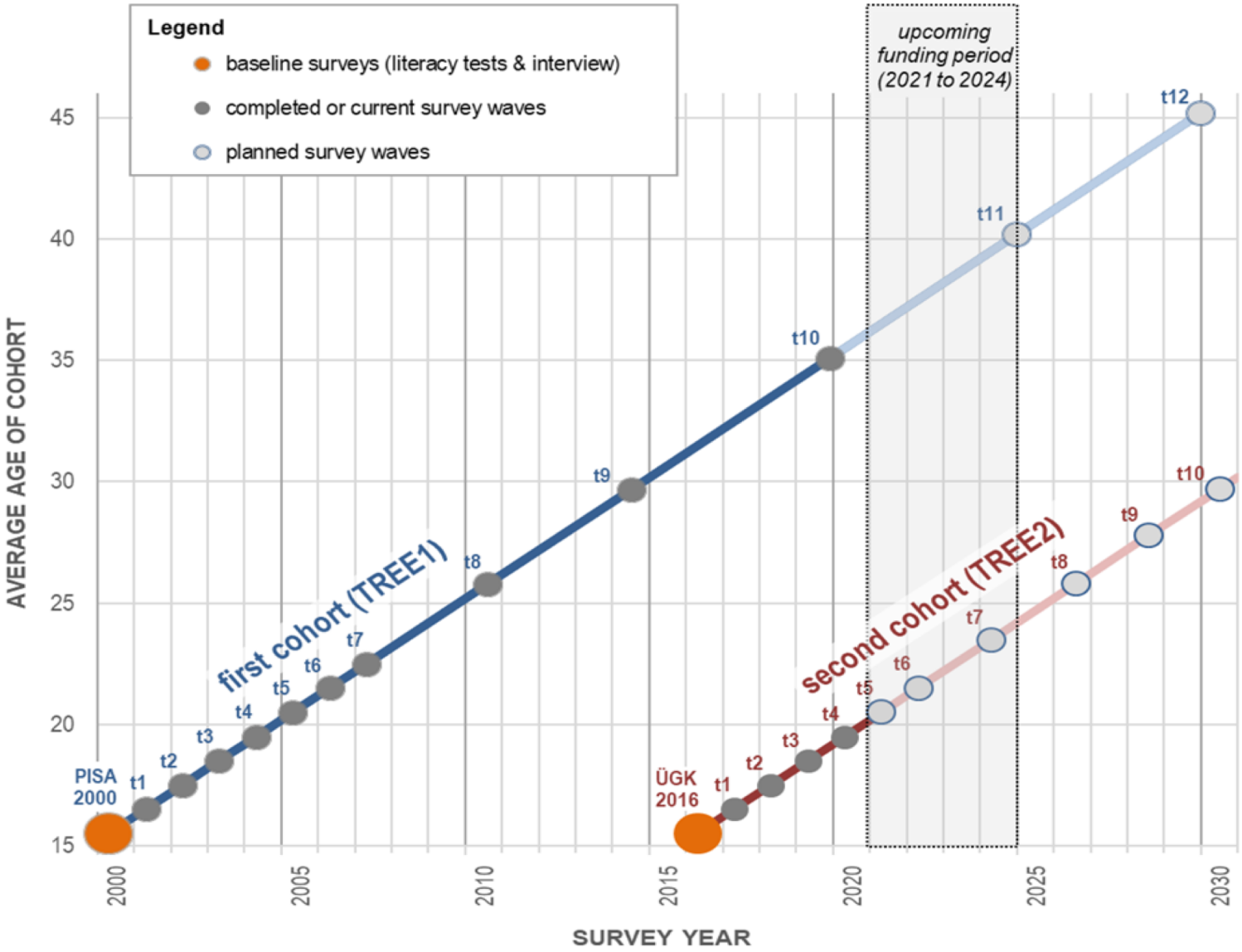
- The TREE panel study
- Application: Gender, mathematical self-concept, and occupational choice: New evidence from the second TREE cohort
  - Motivation and hypotheses
  - Data and methods
  - Results
  - Conclusions

The TREE panel study

TREE = Transitions from Education to Employment

www.tree.unibe.ch

Study design



Survey instruments

- Detailed (month by month) collection of education, labour market & other activities
- Context data:
  - socio-demographic data (e.g. SES, migrations background),
  - personality & non-cognitive skills scales (e.g. coping, persistence, etc.)
  - resources & strains
  - values
  - health & well-being
  - critical life events
  - aspirations & plans
  - financial & home/residential situation
  - children, partner, child care situation
- Cognitive skills measures at baseline (PISA or ÜGK scores, grades)

Survey methods

Mixed mode

- CATI interview approx. 20min
  (secondary mode: P&P, CAWI [in preparation])
  - Dependent interviewing based on data from previous waves.
- self-administered (complementary) questionnaire 20-30 minutes (CAWI/P&P), adapted/customized on the basis of CATI data (e.g. student, apprentice, employee questionnaire);

TREE1: Survey design & response rates 1st cohort

Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ø age of sample		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Transition progress of sample		End of compulso-ry school	Transitions from lower sec. to upper sec.				Transitions from upper sec. to tertiary level or labour market									
										Transitions from tertiary level to labour market or consolidation of labour market entry						
Surveys		PISA 2000	TREE panel 1	TREE panel 2	TREE panel 3	TREE panel 4	TREE panel 5	TREE panel 6	TREE panel 7			TREE panel 8				TREE panel 9
Sample size and response rates	valid sample		6'343	5'944	5'605	5'344	5'048	4'852	4'665			4'571				4'404
	response absolute		5'532	5'210	4'880	4'680	4'507	4'138	3'953			3'424				3'143
	% response/panel		87%	88%	87%	88%	89%	85%	85%			75%				71%
	% response total		87%	82%	77%	74%	71%	65%	62%			54%				50%

TREE1: Particularities of the dataset

- Detailed longitudinal data on education and labour market pathways over 20 years (age 16-35);
- Standardised literacy skills assessment at baseline (PISA)
- Abundant context data
- Representative for a Swiss school leavers population at national and regional/cantonal levels;

TREE1: Data availability

- 9 waves, observation span of 14 years (2000 to 2014; age 16 to 30)
- Episodic data on all job episodes 2003 to 2014
- Available to the scientific community at large,
  online & free of charge (at FORS center/FORSbase, Lausanne)
  https://forsbase.unil.ch/project/study-public-overview/13923/0/
- 10th wave (at ø age 35) conducted in 2020;
  response approx. 3.000 cases
- Data of 10th wave available in 2022

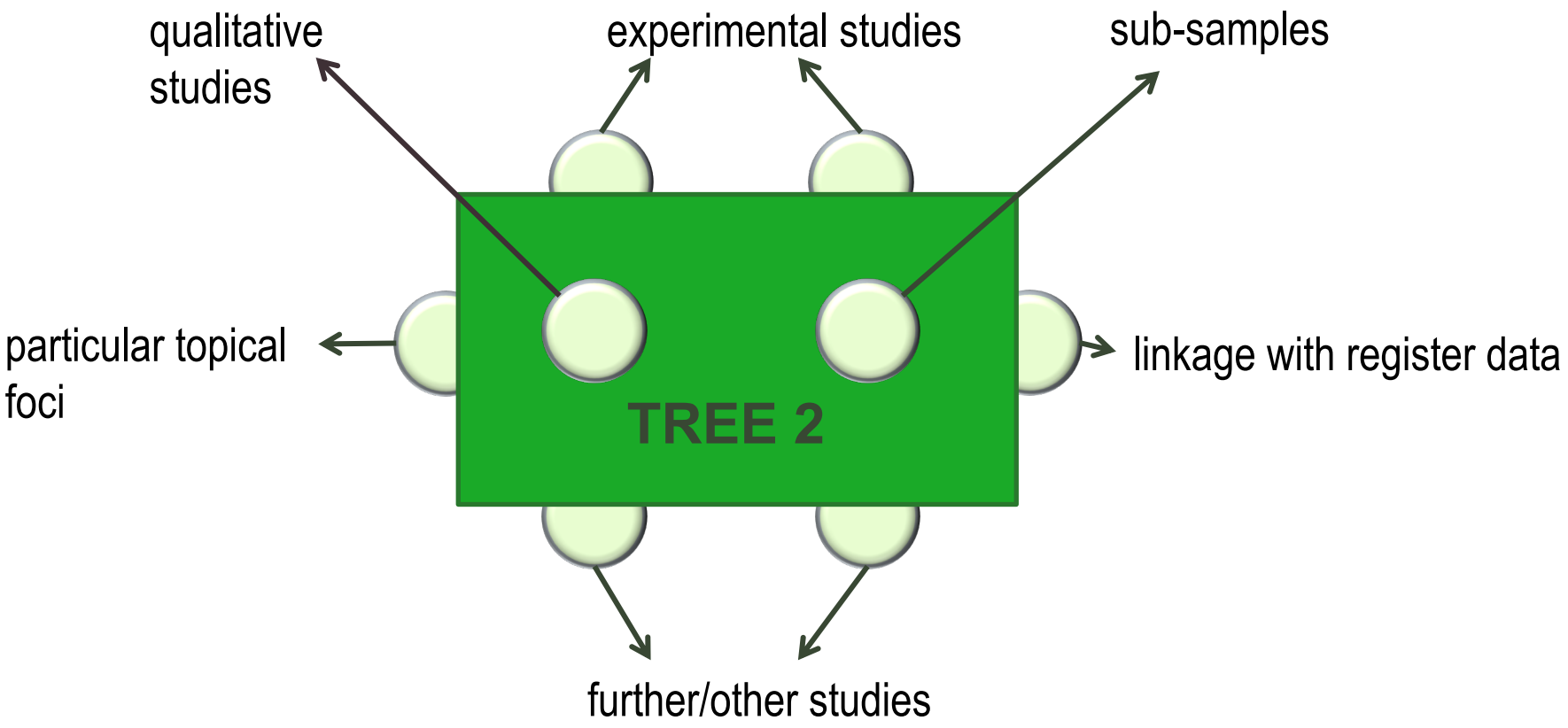
TREE2: 2nd cohort

- Replication of TREE1 (with some extensions, adjustments and improvements)
- Baseline survey: Assessment of the Attainment of Educational Standards (AES; national standardised math test 9th grade) in 2016
- Larger and more balanced sample than TREE1 (gross initial sample N ≈ 10'000)
- Response wave 2/2018: approx. 6.900 respondents
- A first TREE2 data release (baseline, waves 1 and 2) has been made available earlier this year; a second release including waves 3 and 4 will follow in early 2022

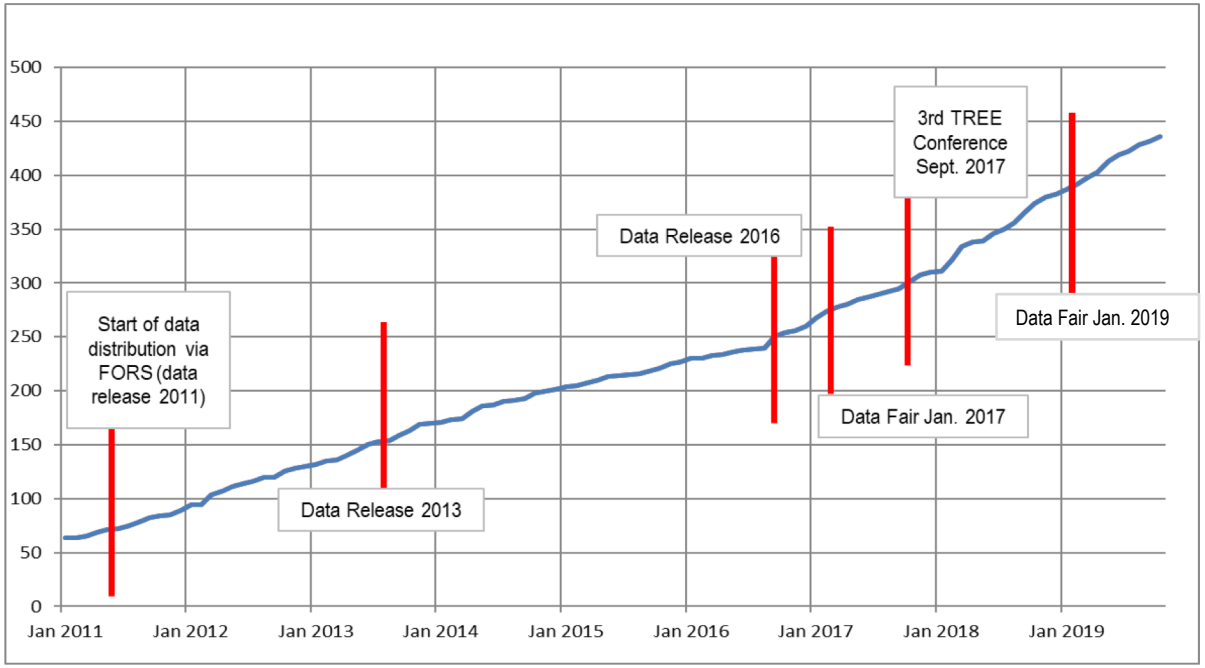
  https://forsbase.unil.ch/datasets/dataset-public-detail/17413/2259/

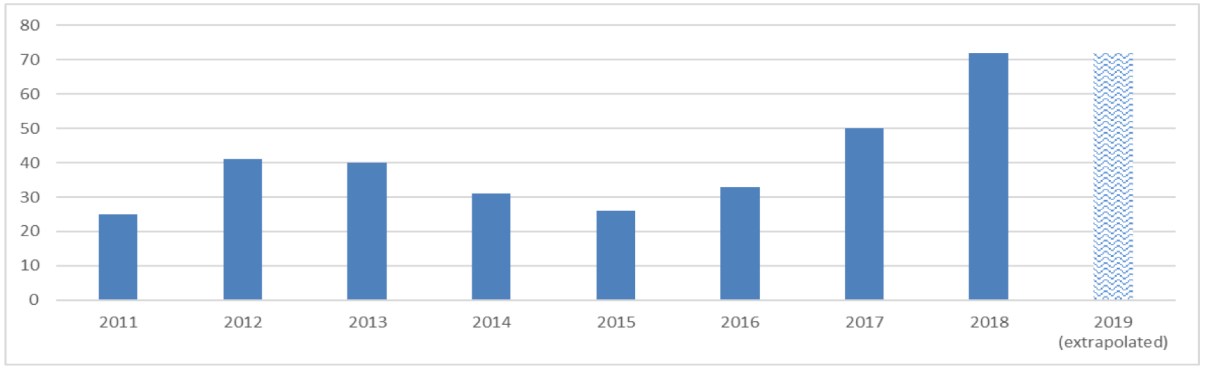
- For details on TREE2 see:
  Hupka-Brunner et al. (2021). TREE2 study design. https://doi.org/10.48350/152018

TREE2 as a base survey for complementary studies («Lego» design)



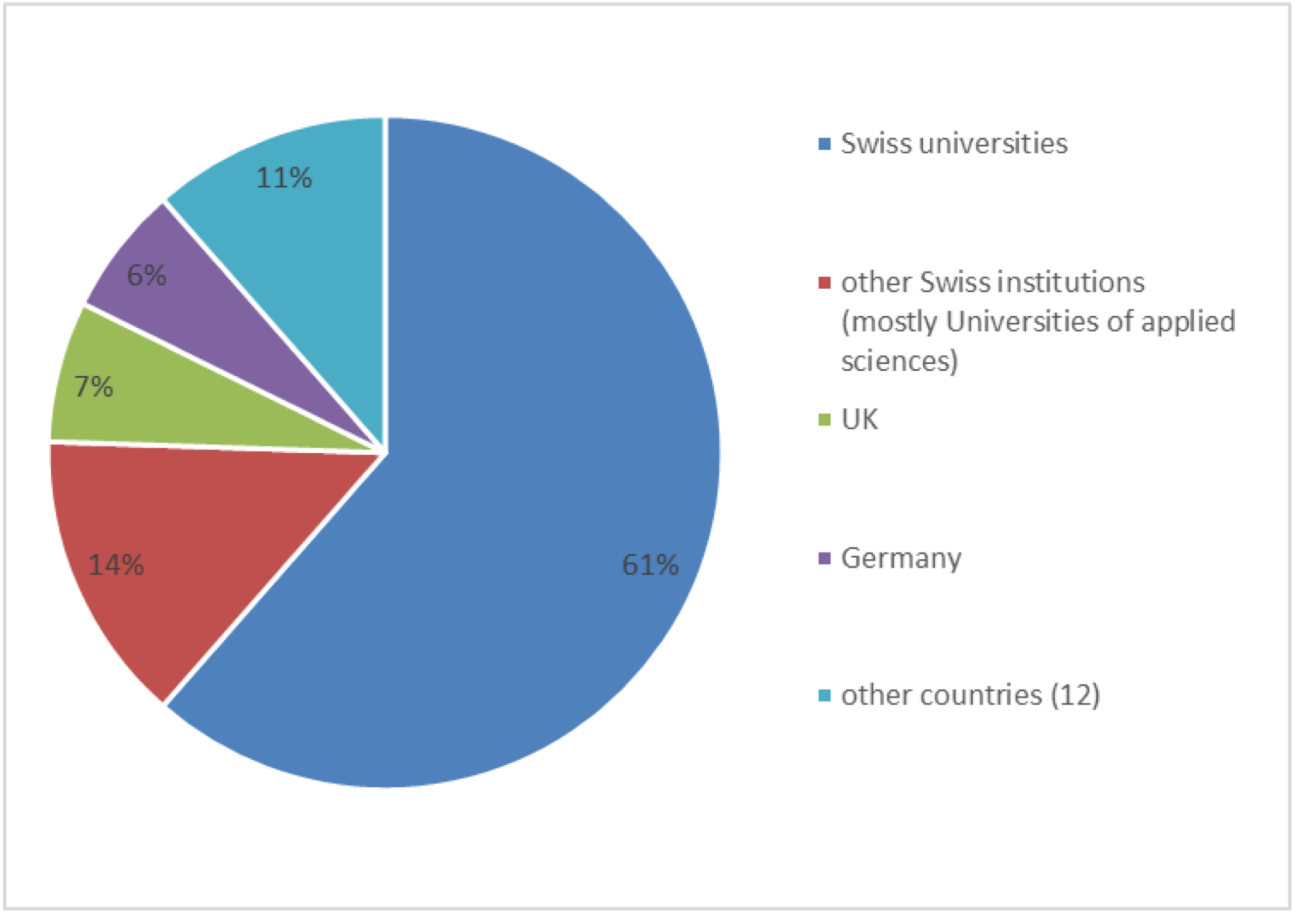
TREE data use: cumulative development 2010-2019



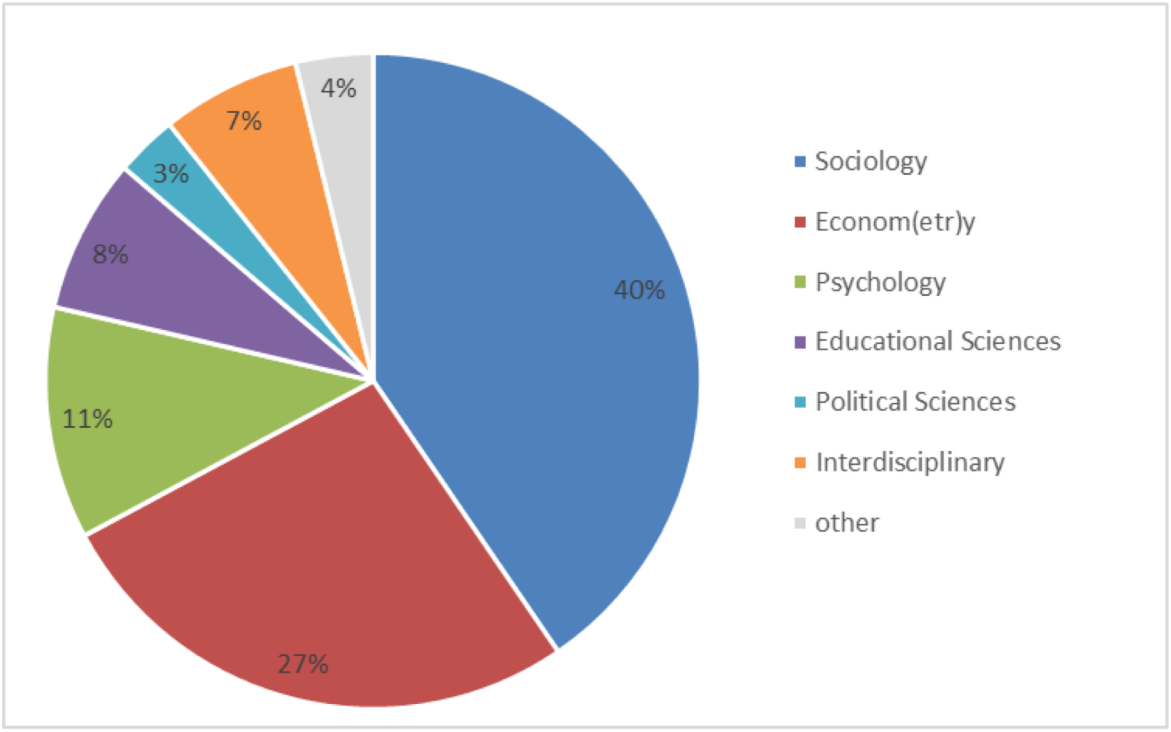


- National "Social science infrastructure"
- Among 5 most widely used datasets in Switzerland

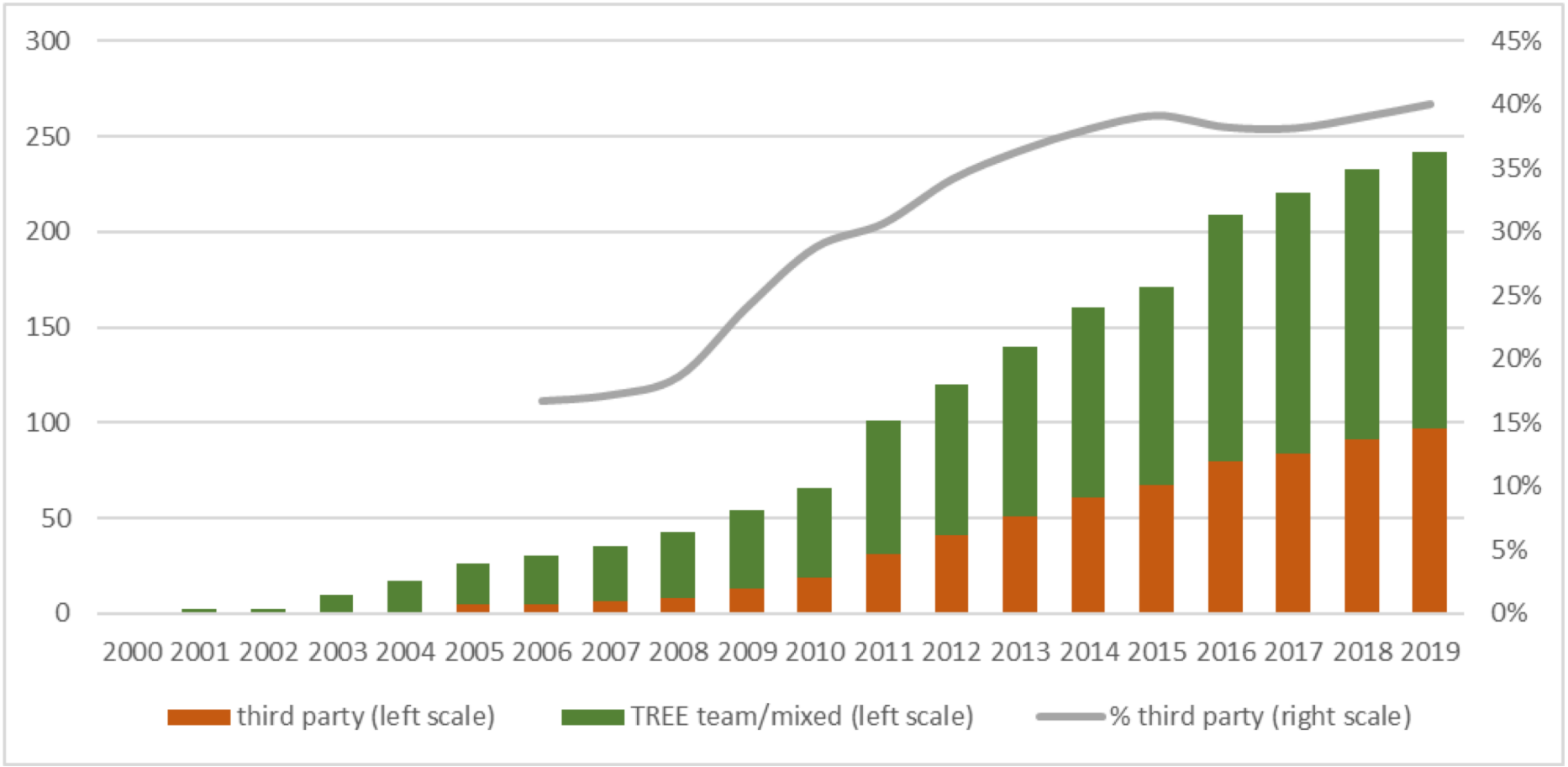
TREE data use 2016-2019 by institution/country



TREE data use 2016-2019 by discipline/field of research



Publications based on TREE data: cumulative development 2000-2019



Full bibliography: www.tree.unibe.ch/results

Gender, mathematical self-concept, and occupational choice: New evidence from the second TREE cohort

Why do women so rarely become STEM professionals?

- Since decades, Switzerland has a shortage of professionals in STEM occupations (Science, Technology, Engineering, Mathematics).
- Furthermore, there is huge gender gap in STEM.
- Consequently, there is a lot of educational policy to make STEM training more attractive for females.
- These efforts have only been mildly successful so far. Occupational gender segregation remains very pronounced in the Swiss labor market.
- But why do women so rarely decide to become a STEM professional?

Hypotheses

- Generally, occupational gender segregation may have various causes (e.g. interplay between labor market and family policy, stereotypes, gendered education, …).
- With respect to STEM, however, gender-specific skills in math and analytic thinking will be relevant.
- It is very obvious:
  - Women are not fit for math and this is why they do not want to become STEM professionals.
  - Probably something about the brain; let's ask the evolutionary biologists.
- Well, as social scientists we don't like this explanation.

Hypotheses

- Self-fulfilling prophecy:
  - Even if we do observe a gender difference in math skills, this does not mean that there is a (biological) difference in talent.
  - It seems obvious that gender stereotypes affect socialization and math learning.
  - For example, there is evidence that the behavior of teachers matters (e.g. gender bias in grading).
  - Also, stereotypes will affect the effort that children put into their math learning.
  - As a consequence, the stereotype becomes true.

Hypotheses

- The role of the mathematical self-concept:
  - We further argue that gender stereotypes affect how women and men evaluate their own skills ("It can not be what may not be").
  - In particular, we argue that women underestimate their math skills compared to men. That is, on average, among women and men with identical math skills, women are less confident in their skills than men.
  - Because women "think" that they are not good at math, they are opposed against STEM, even if they would have the necessary skills.

- This is the hypothesis that we want to test.
  - Can we find evidence for such a gendered evaluation of one's own skills?
  - Do educational decisions depend on such a gender-bias?

Data

- AES 2016 (Assessment of the Attainment of Educational Standards; UGK): Baseline measurement of math skills, mathematical self-concept, and occupational aspirations among a sample of over 20'000 school leavers (at about age 15).
- Wave 1 of the second cohort of TREE: Information on the actual educational situation one year after leaving school for a subsample of these school leavers.
- The analysis only includes respondents who provided a valid answer to the question on their likely job when they will be 30 years old (75% of respondents). No evidence that this introduces a gender bias into the results.

Measures

- Measure of math skills: WLE score from the extensive AES math assessments covering the Swiss curriculum.

- Two measures for the mathematical self-evaluation
  - general "self-concept" (agreement with questions such as "I am good at math" etc.)
  - specific "self-efficacy" ("How likely can you solve the following tasks?"); for simplicity, we use the arithmetic mean from four subscales (calculation, algebra, geometry, probabilities)

- Two measures for STEM aspiration
  - AES 2016: classification of the "job at the age of 30" into STEM professionals (at tertiary education level) and other occupations based on Gehrig et al. (2010)
  - TREE: classification of current educational track into tracks that likely lead to a STEM profession and other tracks

Gehrig, M., Gardiol, L. & Schaerrer, M. (2010). Der MINT-Fachkräftemangel in der Schweiz. Ausmass, Prognose, konjunkturelle Abhängigkeit, Ursachen und Auswirkungen des Fachkräftemangels in den Bereichen Mathematik, Informatik, Naturwissenschaften, Technik. Bern: Staatssekretariat für Bildung und Forschung SBF.

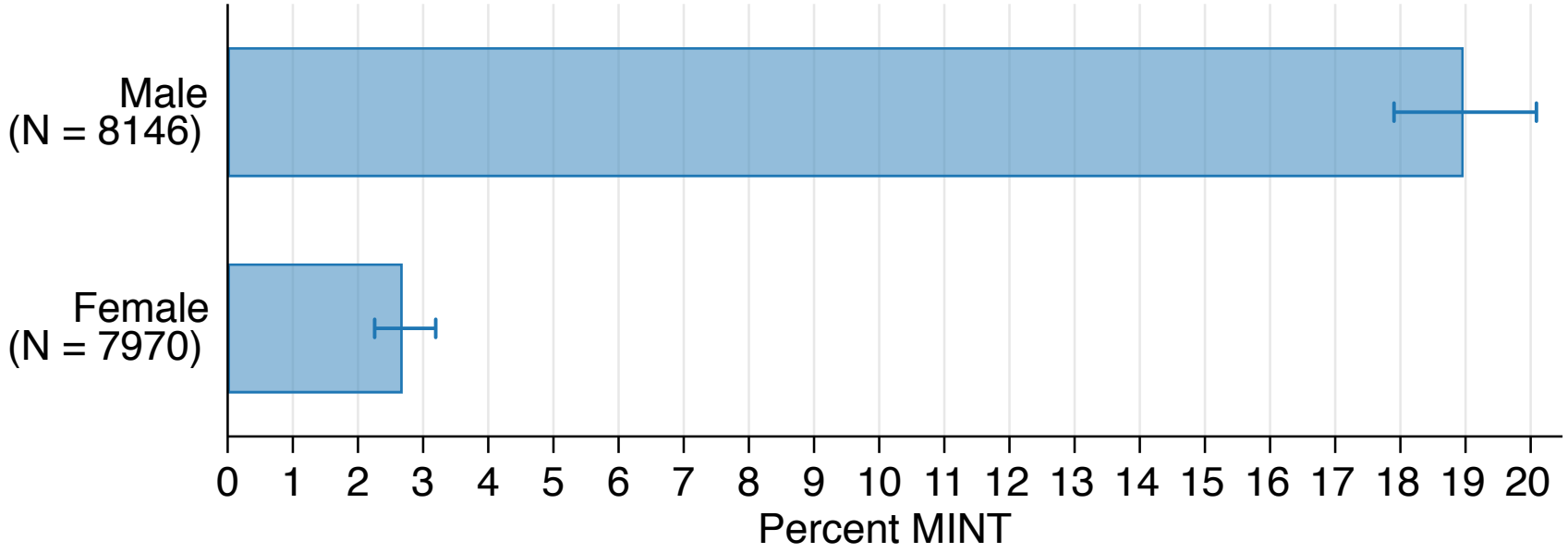
Methods

- We quantify under- and overestimation of one's own skills by comparing respondents' ranks in the distribution of skills and the distribution of self-evaluations.
  - A positive rank difference points to a relative overestimation, a negative difference points to a relative underestimation.
  - If there is no gender bias in self-evaluation, the average rank difference will be zero for both men and women.

- To quantify the effect on STEM aspirations, we conduct Oaxaca-Blinder decompositions (for binary dependent variables) accounting for skills as well as the rank differences between skills and self-evaluation.

Results: Raw gender difference in STEM aspirations

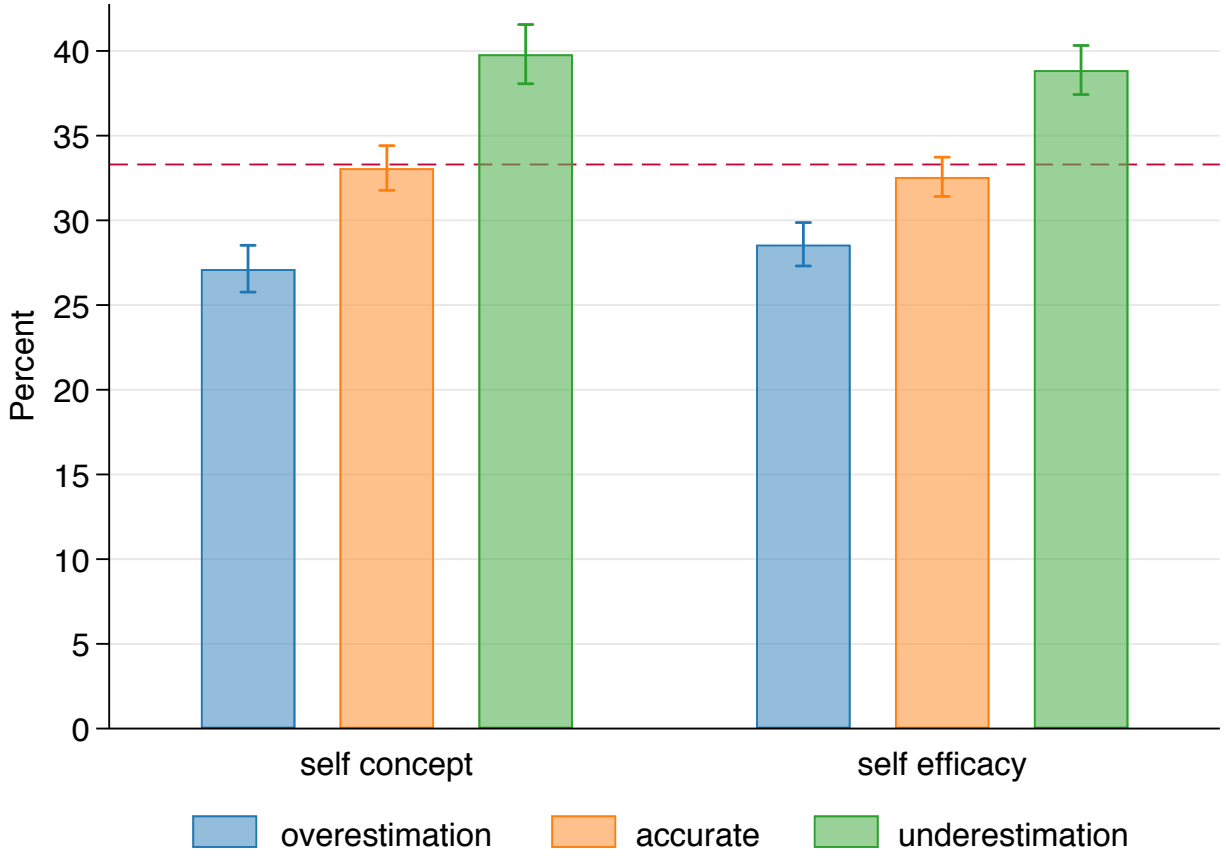
- Gender gap in MINT aspirations (job at 30)



- Gender difference is about 16 percentage points

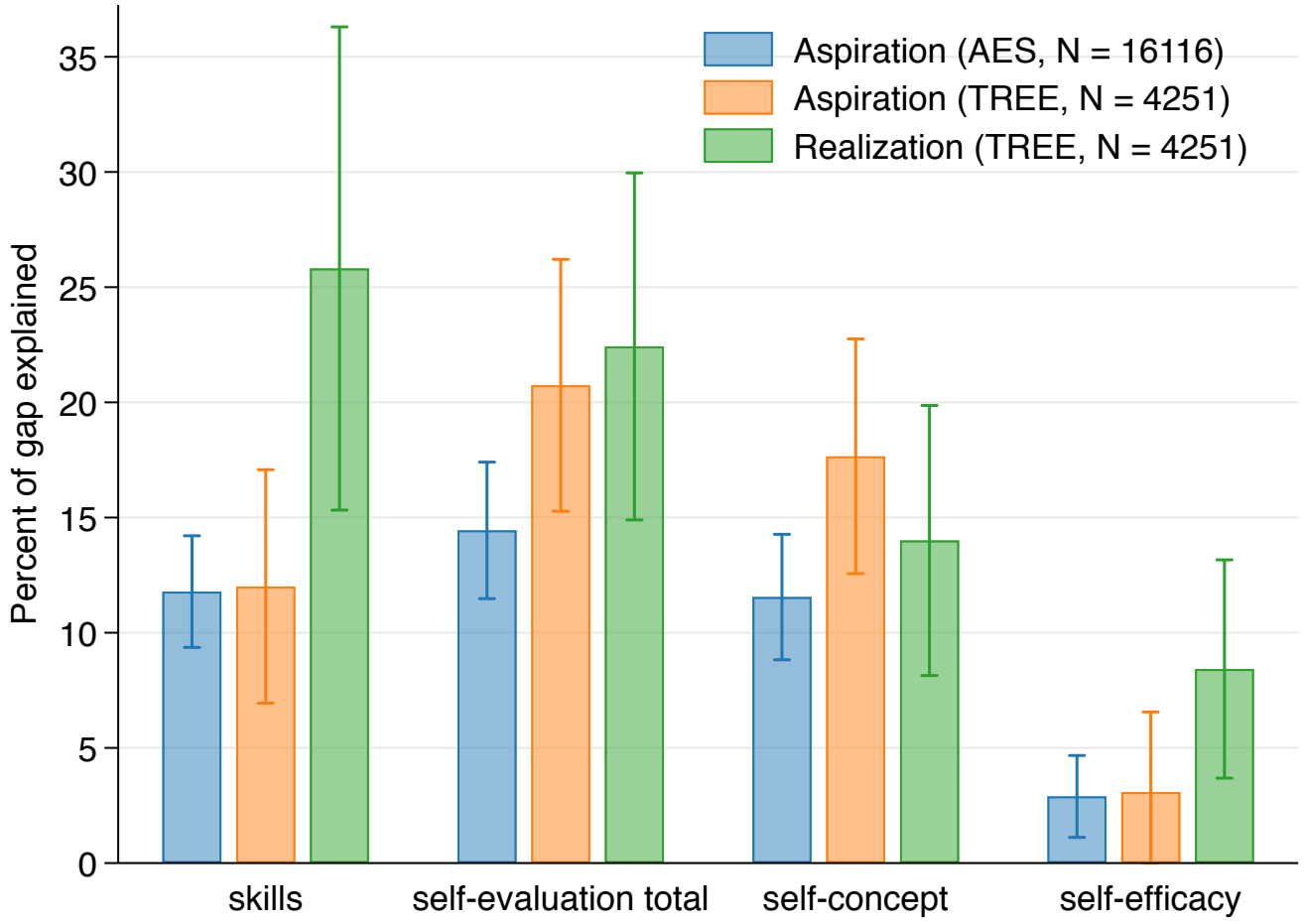
Gender bias in mathematical self-evaluation

- Distribution of females across terciles of rank differences between skills and self-evaluation



(The gender gap in average rank differences is 11 and 7 points, respectively. Correlation between self-evaluation and skills is 0.35 and 0.60, respectively.)

Explanation of STEM gender gap (OB decomposition)



(using rank differences between skills and self-evaluation; results show contribution of gender gap in self-evaluation over and above skills gap)

Conclusions

- Skill differences between women and men explain some of the gender gap in STEM aspirations/choice (although, of course, these skill differences may already be a result of stereotypes affecting learning).
- Also the self-evaluation of these skills plays an important role: females are less likely to choose STEM because they underestimate their skills compared to men.
  - That is, women's lower preference for STEM fields is related to their lower confidence in their mathematical skills, independently from their true skills.
  - The general self-concept seems more important for aspirations; for the realized educational choice, the specific self-efficacy becomes more important.
- The difference in the self-concept is most likely due to gender stereotypes; hence, at least part of the gender STEM gap is due to gender stereotypes that affect women's confidence in their own skills.
- If you want hear more about the mechanisms behind the gender STEM gap, then invite Benita Combet to your Colloque, who implemented a choice experiment on the topic in wave 2 of TREE2.

Life Course in the Making

4th International Conference on Transitions in Youth and Adulthood

11 & 12 November 2021

University of Bern, Switzerland
TREE Study (Transitions from Education to Employment)

Call for Papers

On the occasion of its 20th anniversary and the first release of data of its 2nd cohort, the Swiss TREE (Transitions from Education to Employment) multi-cohort survey and the University of Bern co-organise the 4th International Conference on Transitions in Youth and Adulthood. The conference's focus is on the multi-dimensionality, the intersectionality and the societal embeddedness of various life course stages and transitions. With this focus in mind, it particularly aims at addressing the following topical foci:

- Medium- and long-term effects of earlier transitions on subsequent educational and labour market pathways, especially with respect to the evolution und cumulation of multiple social inequalities (cumulative [dis-]advantages);
- Interdependencies and spill-over effects between various life domains (education, work, family, health, social integration, self);